THE UNIVERSITY OF WISCONSIN

COLLEGE OF LETTERS AND SCIENCE

DEPARTMENT OF GEOLOGY
DIVISION OF GEOPHYSICS

Madison, Wisconsin

UNIVERSITY OF WISCONSIN

Department of Geology

PROGRESS REPORT

Period
June 1, 1953 - December 31, 1953

Seismic Studies in the Southern Half of the Atlantic Coastal Plain
(Not Classified)

The enclosed represents work done to date under contract N 7 onr-28512, between the Office of Naval Research, U.S. Navy, and the University of Wisconsin.

January, 1954

To: Office Naval Research
Geophysics Branch
Washington, D.C.

From: George P. Woollard
Department of Geology
University of Wisconsin
Madison, Wisconsin

Subject: Progress report on Seismic Studies in the southern half of the Atlantic Coastal Plain.

1. The following report covers work done during the summer field season of 1953 and computations carried out in the fall of 1953 under contract N 7 onr-28512 between the Office of Naval Research of the U.S. Navy and the University of Wisconsin.

2. Objective of Research Program: To establish a series of six seismic refraction depth profiles across the Atlantic Coastal Plain south of Cape Hatteras, North Carolina in order to determine:

   (a) the depth of sediments overlying the pre-Cretaceous erosion (basement) surface.

   (b) the geologic structure within the sedimentary section.

   (c) the nature of the rocks comprising the basement surface.

   (d) the configuration of the basement rock surface.

3. Field Program: During the summer of 1952, seismic measurements of the depth to the basement rock surface underlying the Coastal Plain were completed at 22 locations. During the summer of 1953, additional determinations were made at 35 localities raising the total to 57 in all. The localities at which depth determinations have been made to date are indicated in Fig. 1.

The above measurements were established for the most part using the reverse profile shooting method in order to determine true velocities for the seismic

discontinuities encountered and the dip of each seismic discontinuity surface.

In addition to the above measurements a series of surface rock velocity determinations were carried out in selected outcrop areas to ascertain characteristic velocity values for the rocks comprising the pre-Cretaceous erosion surface where it is exposed in the Piedmont Region of Georgia, South Carolina and North Carolina. During the summer of 1952 such velocity determinations were made at 30 localities. During the summer of 1953, determinations were made at 20 new locations. The locations of all observational sites are indicated also in Fig. 1.

4. Comments on Field Observations: No great difficulty was experienced in making the field measurements for depths less than 2000 feet. In trying to work to greater depths though, trouble was experienced from several sources. These sources of trouble fall into four distinct categories:

(a) accessibility of area in laying out shot and reception spreads particularly for reverse profile shooting.

(b) limited sensitivity of receiving and recording equipment requiring large charges of explosives in order to get satisfactory results.

(c) hostility of native population in part induced by requirements under item (b).

(d) limited reception of mobile radio equipment used when in densely forested areas.

4a). As this section of the country which was settled by the first colonists was forested at the time of settlement, the road system in large measure followed Indian and game trails. There has been no subsequent development of a section line grid system of roads such as is found over most of the more recently developed sections of the country and as a consequence, most of the roads other than the modern federal trunk highways are random in distribution and meander so that it is difficult to lay out instrument spreads following straight lines for two or more miles. The straight trunk highways can not be

used because of the high background noise resulting from traffic and also because it would not be feasible to locally stop traffic in the recording area at the times of measurements. There is also the problem of legally shooting explosives in the quantities required adjacent to such highways. Between the difficulties imposed by the road system, the forested and undeveloped nature of the intervening ground ruling out cross country travel, the increase in large swamp areas as the coast is approached necessitating in some cases lengthy detours, and the increase in the depth of the basement surface as the coast is approached requiring longer spreads, the program was slowed down considerably. As a consequence, progress in terms of results obtained for the time spent was not as great as in the summer of 1952.

4b). Because of the limited sensitivity of the equipment (Century 12 channel portable refraction seismograph field unit), charges of 35 to 50 pounds of T.N.T, were required to get satisfactory records when the spread between shot point and receiving equipment was much over a mile. Part of the requirement for large charges can also be attributed to high absorption of energy in the swamp muck and peat both at the surface and buried along the transmission path. This limitation is in no way an adverse criticism of the Century equipment since it was designed for shallow depth measurements (up to 500 feet) and we were able to successfully use it to establish depths in excess of 2000 feet. However, more sensitive equipment is needed to adequately work that part of the area having depths greater than 2000 feet.

4c). Despite advance letters to the sheriffs of every county in the operations area and letters of endorsement from state officials, there was a lack of cooperation from the native population as a whole and in some instances there was open hostility. Although the field party was not jailed as was the case in 1952, there was a considerable demand upon the chief of the party, Mr. Bonini, for tact, diplomacy, and adaptability to make the best of poor situations. He is to be commended for both keeping his party out of jail and successfully obtaining as many results as he did.

4d). Another factor that placed a limitation on the program was the range of good radio reception. Permission could not be obtained from the F.C.C. to use the radio equipment

it was originally planned to use and the frequency finally assigned entailed building new equipment. Because of limited funds for this purpose the equipment built was not as good as was desired and while it tested satisfactorily in the open country around Madison, it was not satisfactory beyond a couple of miles in the forested coastal areas of the Carolinas. This automatically precluded the possibility of obtaining the shot instant where the depths would be much over 3000 feet, and when a separation of about three miles was required between the shot point and the receiving equipment.

Therefore, for several reasons it was not possible to complete all of the six seismic traverses started in the summer of 1952. Further, because of the slow progress made, it was not possible to start any depth measurements in Georgia as originally planned.

5. Results: The general geologic structural pattern reported last year in which three seismic horizons were found to be present above the basement appears to still hold. These horizons characterized by velocities of 2600 - 4000 ft./sec., 5700 - 6800 ft./sec. and 7000 - 8000 ft./sec., however, are not encountered at every place studied. The first two are practically always present but the third occurs only at about half the stations. In general, this horizon does not occur, except where the depth of sediments is greater than 400 feet. The horizon itself does not appear to outcrop and has not been detected at depths shallower than 60 feet below the surface.

The upper seismic discontinuity, having general distribution, probably represents the position of water table and is occasioned by the transition in velocity in going from partially water saturated sediments to completely water saturated sediment.

As is generally known, the basement includes a host of diverse rock types ranging from Triassic sandstones and shales to granites, schists and gneisses. It is therefore not surprising that the basement velocities vary from 15,000 ft./sec. to 23,000 ft./sec.

Computations are still in progress on the results obtained this year and therefore no new results will be presented at this time.

6. Future Work: In view of the many difficulties mentioned under paragraph 4, it is believed it would be preferable this coming summer to modify the original program and try and complete the general picture outlined by the work to date by carrying out a series of off shore seismic measurements; this work to be done in shallow coastal water area. With this in mind a series of tests were carried out in Lake Mendota through the cooperation of the Lake Laboratory and in Lake Michigan through the cooperation of the U.S. Coast Guard. The Lake Mendota tests were purely as a check on instrument performance and involved equipment on loan from the Humble Oil Co. with four gymbal mounted seismic detectors strung out on the bottom. The Lake Michigan test was more in the nature of an operational test. Two picket boats were used and reverse profiles were shot in depths of water ranging from 50 to 150 feet. The results while not completely worked up at this time appear to be good. Each detector was recorded with two gain settings on a 12 channel oscillograph along with the water wave as recorded by a hydrophone and the shot instant as recorded by radio.

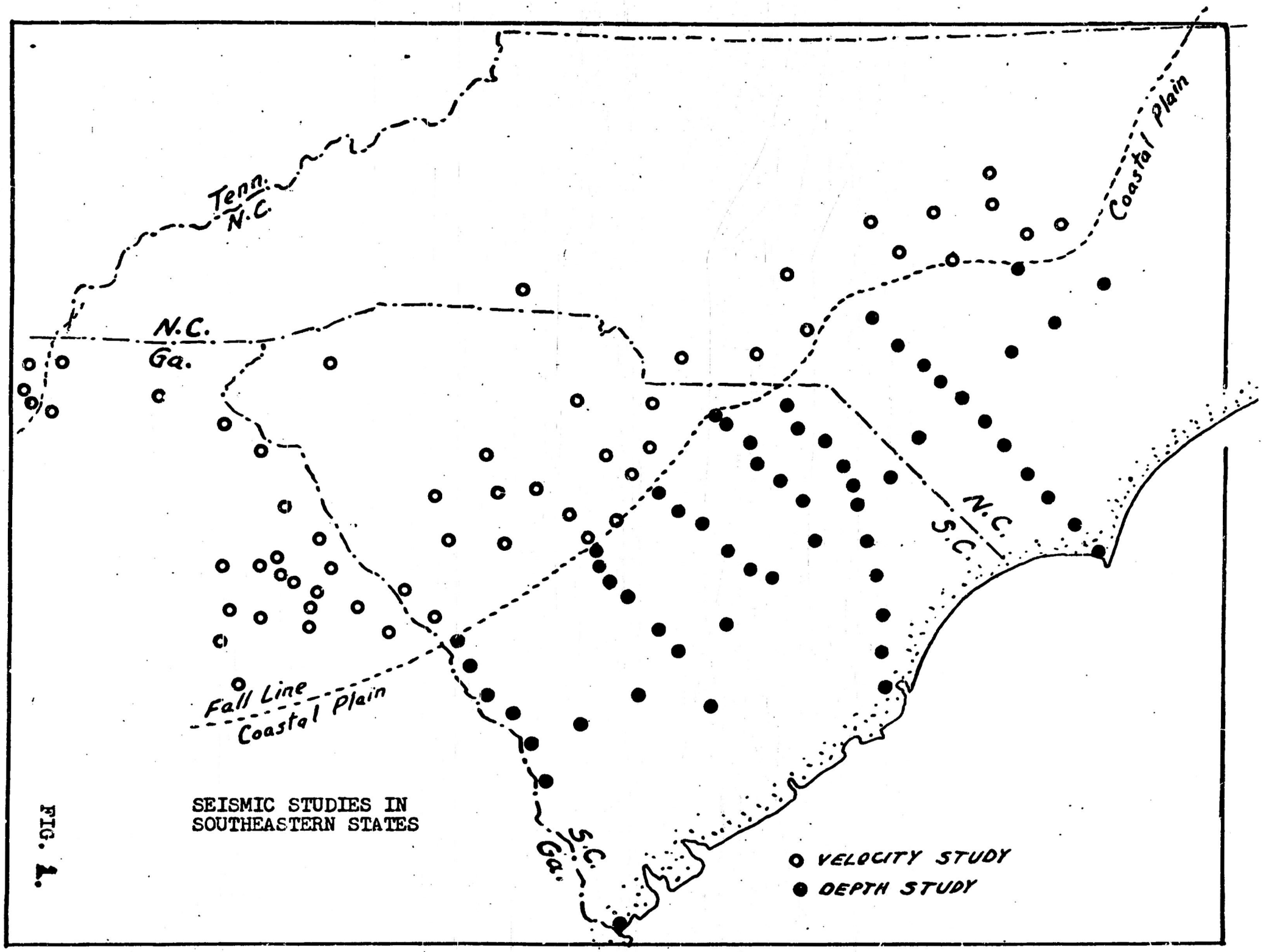
A minimum program for the coming summer would be to set at least two off shore stations as extensions of the land traverses. These would serve for extrapolating the slopes of the seismic discontinuities mapped on land across the intervening coastal area where it is so difficult to operate.

An alternate program would be to run two traverses parallel to the coast from Wilmington, N.C. down to the Georgia - Florida line. These two traverses would be approximately one and twelve miles off shore, respectively with stations at about 10 mile intervals along each. These traverses would give off shore data on the Cape Fear axis which on the basis of all land information is a geologic feature striking perpendicular to the coast; some possible information regarding the fault extending perpendicular to the coast through Charleston, S.C. which is quite active on the basis of earthquake observations; across the south Georgia Basin, and across the

postulated scissor fault near the Georgia - Florida line. In addition it might delineate where crystalline type basement rocks are replaced by the unaltered Paleozoic rocks found in Florida.

An additional type of information that could be gained, since the detectors would be on bottom, would be the velocity of sound transmission in the various types of bottom sediments encountered. To make this part of the study meaningful, it would be desirable to have the shooting boat equipped with an underway bottom sampler. Since all distance determinations will depend upon the speed of sound transmission through the water, bathythermograph observations would also be needed and the sampler could be mounted on the nose of the bathythermograph.

7. Acknowledgements of Assistance: The help extended by Mr. Lawrence Smith, State Geologist of South Carolina, Mr. Jasper Stuckey, State Geologist of North Carolina, and Mr. Garland Peyton, Director of the Bureau of Mines, Mining, and Geology of the State of Georgia in laying out and implementing the present program is gratefully acknowledged. Likewise, thanks are due Mr. Goff Gibson, of the A.E.C. Radiation Control Division of the Dupont Co. for assistance extended in making measurements in the restricted area at the A.E.C. Savannah River Project. Thanks are also due the Kraft Paper Co. for assistance in making test measurement near Savannah, Georgia where the depth to basement is estimated to be of the order of 4000 feet. Through the cooperation of the Kraft Paper Co. it was possible to lay out a spread on their properties extending about four miles and to shoot explosive charges that ran up to 200 pounds of T.N.T.



SEISMIC STUDIES IN
SOUTHEASTERN STATES

FIG. 1.